PRONGHORN 2016

27th Biennial Western States and Provinces

Pronghorn Workshop

Hosted by Montana Fish, Wildlife & Parks
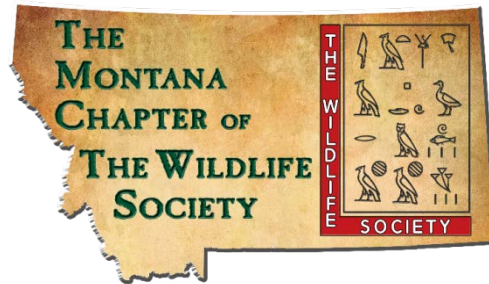
Montana Fish, Wildlife & Parks

August 29 – September 1, 2016

Fairmont Hot Springs, Montana

Cover art and conference logo by Luke Duran, Montana Fish, Wildlife & Parks

Workshop Sponsors

27th Biennial Pronghorn Workshop: Schedule At-A-Glance
Habitat: Where has all the Grassland Gone?

Monday, August 29

4:00 – 6:00 PM	Registration, Exhibitor Set-Up and Check-In
5:00 – 8:00	Welcoming Reception (refreshments and appetizers included in registration)

Tuesday, August 30

7:00 – 8:00 AM	Breakfast (included in registration) Registration, Exhibitor Set-Up and check-In
8:00 – 8:25	Welcoming Comments, Housekeeping
8:25 – 10:40	Plenary Session (Fencing: A Tool or Obstacle for Managing & Conserving Wildlife?)
10:40 – 11:00	Break
11:00 – 12:00 PM	Presentations (Session 1)
12:00 – 1:00	Lunch (included in registration)
1:00 – 3:00	Presentations (Session 2)
3:00 – 3:20	Break
3:20 – 5:00	Presentations (Session 3)
5:00 – 5:30	Poster Session
6:00 – 9:00	Dinner (included in registration)

Wednesday, August 31

7:00 – 8:30 AM	Breakfast (included in registration)
8:30 – 4:30 PM	Field Trip (lunch included in registration)
6:00 – 9:00	Banquet & Awards Ceremony (included in registration) Featured speaker: Matt Kauffman, Director of the Wyoming Migration Initiative "Research and Conservation of Wyoming's Big Game Migrations"

Thursday, September 1

7:00 – 8:20 AM	Breakfast (included in registration), Business Meeting
8:20 – 10:20	Presentations (Session 4)
10:20 – 10:40	Break
10:40 – 11:20 PM	State & Province Status Updates
12:00 – 1:00	Lunch (on your own)

Monday, August 29

Start Time	End Time	
16:00	18:00	Registration, Exhibitor set-up, check-in
17:00	20:00	Welcoming reception (refreshments and appetizers included with registration)

Tuesday, August 30

Start Time	End Time	
7:00	8:00	**Breakfast (included with registration), Exhibitor set-up, and check-in**
8:00	8:25	**Welcoming comments, Lieutenant Governor Mike Cooney**
		Plenary Session- Fencing: a tool or obstacle for managing and conserving wildlife?
		Moderator: Andrew Jakes, University of Montana
8:25	8:40	Rob Ament- Effectiveness of mitigation measures to reduce the impacts of transportation on wildlife movement and mortality
8:40	8:55	Renee Seidler- Fencing: a tool or obstacle for managing & conserving wildlife?
8:55	9:10	Glen Dickens- Arizona Game & Fish Department & Arizona Antelope Foundation connectivity projects & results
9:10	9:25	Abel Guevara- Utilizing research to manage resources on public lands
9:25	9:40	Paul Jones- Prairie fences: reason to be concerned or just part of the landscape?
9:40	9:55	Christine Paige- Making it happen: outreach and partnerships for wildlife friendly fences
9:55	10:40	Group Discussion - Audience and Panel
10:40	11:00	**BREAK**
		Contributed Presentations Session 1- Fences
		Moderator: Melissa Foster, Montana Fish, Wildlife & Parks
11:00	11:20	Paul Jones- Evaluating the use of modified fence sites by pronghorn in the Northern Sagebrush Steppe
11:20	11:40	Whitney Gann- Fence crossing of translocated pronghorn in the Trans-Pecos, Texas

11:40	12:00	Emily Burkholder- To jump or not to jump: mule deer (*Odocoileus hemionus*) and white-tailed deer (*Odocoileus virginianus*) crossing decisions
12:00	13:00	**LUNCH**

Contributed Presentations Session 2- Population dynamics and management
Moderator: Adam Grove, Montana Fish, Wildlife & Parks

13:00	13:20	Ryan O'Shaughnessy- Does birth synchrony influence fawn survival of pronghorn in the Trans-Pecos region of Texas?
13:20	13:40	Brett Panting- Environmental constraints on pronghorn neonate survival across Idaho
13:40	14:00	Emily Conant- Assessing translocated pronghorn adult and fawn survival in New Mexico
14:00	14:20	Shawn Gray- Post-release survival of translocated pronghorn on the Marfa Plateau, Texas
14:20	14:40	Justin Paugh- Creation and evaluation of trend areas that predict pronghorn populations to guide management actions
14:40	15:00	Caroline Ward- Evaluation of aerial population estimation techniques for pronghorn antelope in Texas
15:00	15:20	**BREAK**

Contributed Presentations Session 3: Habitat delineation and conservation
Moderator: Brad Schmitz, Montana Fish, Wildlife & Parks

15:20	15:40	Scott Bergen- Determinants of pronghorn antelope seasonal range and migration in the Upper Snake River Plain, Idaho
15:40	16:00	Andrew Jakes- Factors influencing seasonal migrations of pronghorn across the Northern Sagebrush Steppe
16:00	16:20	Joseph Smith- Reducing cropland conversion risk to sage-grouse through strategic conservation of working rangelands
16:20	16:40	Catherine Wightman- Montana's grassland conservation strategy
16:40	17:00	Glen Dickens- Arizona Antelope Foundation southeastern Arizona grasslands pronghorn initiative
17:00	17:30	**Poster Session**
18:00	21:00	**Dinner (included with registration)**

Wednesday, August 31

Start Time	End Time	
7:00	8:30	**Breakfast (included with registration)**
8:30	16:30	**Field Trip (lunch included with registration)**
18:00	21:00	**Banquet & Awards Ceremony (included with registration)**
		Banquet MC: Julie Cunningham, Montana Fish, Wildlife & Parks
		Featured Speaker:
		Matt Kauffman- Research and Conservation of Wyoming's Big Game Migrations

Thursday, September 1

Start Time	End Time	
7:00	8:20	**Breakfast (included with registration), State & Provincial Business Meeting**
		Contributed Presentations Session 4: Population dynamics and management
		Moderator: Sonja Andersen, Montana Fish, Wildlife & Parks
8:20	8:40	Keri Carson- Hemorrhagic disease in Montana pronghorn
8:40	9:00	Mark Hebblewhite (Dan Eacker)- Impacts of severe winter weather on pronghorn survival in partially migratory populations
9:00	9:20	Adele Reinking- Survival of pronghorn in Wyoming's Red Desert: the influence of intrinsic factors and environmental and anthropogenic change
9:20	9:40	James Hoskins- Finding new ways to manage pronghorn populations in the Texas panhandle- update
9:40	10:00	Philip Boyd- Modeling translocation strategies for pronghorn populations in the Trans-Pecos, Texas
10:00	10:20	Jay Gedir- Predicting long-term pronghorn population dynamics in the southwest in response to climate change
10:20	10:40	**BREAK**
		State & Province status updates
10:40	11:20	John Vore, Montana Fish, Wildlife & Parks - Overview of pronghorn status in the Western States and Provinces
		Lunch on your own

Abstracts – Plenary Session, 2016
Alphabetical by First Author

EFFECTIVENESS OF MITIGATION MEASURES TO REDUCE THE IMPACTS OF TRANSPORTATION ON WILDLIFE MOVEMENT AND MORTALITY

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An overview of different highway measures that have been developed to reduce collisions with large wildlife (primarily ungulates) on roads will be presented, many which also improve habitat connectivity for all types of species. Those measures most appropriate to mitigate roads for pronghorn will be emphasized. The mitigation measures reviewed can be described to use three general strategies: change wildlife behavior, change driver behavior, separate wildlife from traffic. Many of these measures are ineffective, others are still poorly understood, while some are quite effective. Some of the proven solutions such as wildlife underpasses or overpasses with fencing, and electronic systems that automatically detect wildlife nearby and warn drivers, again using fencing, have been shown to reduce wildlife-vehicle collisions by 80 to over 90%. A look at some pronghorn specific research related to road crossings will be described. Despite their initial construction costs, wildlife crossings using infrastructure and fences have been shown to pay for themselves over their lifetime when installed on road segments with moderate to high wildlife-vehicle collision rates. A review of highway rights-of-way fencing will also be discussed.

ARIZONA GAME & FISH DEPARTMENT & ARIZONA ANTELOPE FOUNDATION PRONGHORN CONNECTIVITY PROJECTS & RESULTS

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Established in 1992, the Arizona Antelope Foundation is an organization dedicated to the welfare of pronghorn antelope. The Foundation's Mission is to actively seek to increase pronghorn populations in Arizona through habitat improvements, habitat acquisition, the translocation of animals to historic range, and public comment on activities affecting pronghorn and their habitat. Our bylaws require that we conduct at least 4-work projects per year. In the past 5 years we have conducted 20 such projects all focused specifically on achieving landscape level changes in connectivity for two

specific pronghorn populations through fence removals and modifications. One supporting the *AZ Game and Fish Departments North of Interstate 10 Pronghorn Connectivity Project* and the second in support of our own National Fish and Wildlife Foundation grant funded *Southeastern AZ Pronghorn Initiative*. Results will be presented and have been highly effective and measureable in both project areas. In addition we will outline our newest 5-year connectivity project the *Big Lake Pronghorn Herd Initiative* in response to two years of collar data and seasonal migration corridor definition.

UTILIZING RESEARCH TO MANAGE RESOURCES ON PUBLIC LANDS

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The Bureau of Land Management (BLM) Glasgow Field Office, located in northeast Montana, manages over 1 million acres of public lands. The Field Office has supported several university research projects in the last 10 years and is utilizing research conducted by Andrew Jakes on Pronghorn antelope (*Antilocapra americana*) to develop management strategies that accommodate migrating pronghorn. BLM has focused fence modification efforts on migration corridors identified by this research. The agency has completed 20 miles of fence removal or modification over the last three years. Land management agencies should strive to utilize research that provides direct management strategies and research should strive to provide management applications.

PRAIRIE FENCES: REASON TO BE CONCERNED OR JUST A PART OF THE LANDSCAPE?

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Fences are common place on the prairies of America and have been around since European settlement. Depending on the purpose or function of a fence, or the species of interest, fences can be viewed as either obstacles or tools to conserving wildlife. Most fences are viewed in a negative light due to their impacts on wildlife; direct source of mortality, movement barriers leading to habitat loss and fragmentation, or indirect mortality (hair loss, wounds, etc.). But there are

cases where fences are used strategically to manage wildlife by directing their movements. There are also cases where wildlife use fences strategically for their benefit. Therefore, are species adaptable enough that managers need not worry about the impacts of fences on wildlife or should managers be concerned? So far one could argue that managers are leaning on the side of species adaptability, but is this the right side of the fence to be on when managing wildlife? I will present a technical overview of the interaction of fences and wildlife, with a focus on pronghorn, and provide rational as to why managers need to concentrate efforts on managing fences for the benefit of wildlife that also accounts for the needs of society.

RESEARCH AND CONSERVATION OF WYOMING'S BIG GAME MIGRATIONS

MATTHEW KAUFFMAN, Director Wyoming Migration Initiative, U.S. Geological Survey, Wyoming Cooperative Fish and Wildlife Research Unit, Department of Zoology and Physiology, University of Wyoming Laramie, WY 82071, 307-766-6404 mkauffm1@uwyo.edu

Wyoming harbors vast, open landscapes still capable of supporting long-distance ungulate migrations. Recent research at the University of Wyoming has advanced our understanding of why animals make these migrations and how they are changing due to development. This talk will describe various big game migrations in Wyoming and discuss new findings that are helping researchers understand how and why animals migrate. The talk will also describe research indicating how the responses of migrating ungulates to disturbance, from energy and housing development, hold the potential to diminish the benefits of migration and lead to its loss across impacted landscapes. Because of these threats, the Wyoming Migration Initiative was founded in 2012 with a goal of creating new conservation tools that can facilitate the work of agencies and NGOs to make these journeys easier for migrating ungulates.

MAKING IT HAPPEN: OUTREACH AND PARTNERSHIPS FOR WILDLIFE FRIENDLY FENCES

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Dismayed and inspired by watching a small herd of pronghorn trapped in a ranch road right-of-way by two impassable fences, I researched and wrote the first Landowner's Guide to Fences and Wildlife for Montana Fish, Wildlife and Parks. This and a subsequent version written for the state of Wyoming, present a host of fence ideas and

solutions to create easier passage for wildlife, made user-friendly for landowners and land managers. The booklets went viral and have been adopted by agencies and conservation organizations throughout the western US and internationally. Partnerships are key to successful projects: funding, materials and volunteer labor from agencies and private groups help landowners adapt their fencing for wildlife. A couple of examples include the Jackson Hole Wildlife Foundation volunteer fencing team and Green River Valley Land Trust's initiative to modify fences in the Path of the Pronghorn.

FENCING: A TOOL OR OBSTACLE FOR MANAGING & CONSERVING WILDLIFE?

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Linear impediments on the landscape create an inordinate challenge for pronghorn since pronghorn did not evolve to navigate vertical obstacles. In their native environment on the prairies and plains of western North America, pronghorn evolved speed in a horizontal landscape to evade predators and they have not adapted as readily to fences, roads and traffic as other ungulates. Not only can linear impediments restrict movement, but they can also lead to risk-avoidance behaviors similar to those observed in response to predators, which may lead to reduced vigor of local pronghorn populations. We have found that high road densities, natural gas development, fences and crossing structures (the latter built as a management tool to benefit pronghorn) can change pronghorn movement patterns, reduce utilization of high-quality forage, decrease the success of crossing impediments and increase vigilance. While most linear structures were not built with wildlife needs in mind, more recently some have been built wholly with protection and conservation of wildlife and human safety in mind. Outside of Pinedale, Wyoming, a wildlife highway mitigation project built 6 underpasses, 2 overpasses and 20 kilometers of exclusionary fencing to provide safe wildlife crossings over US Highway 191. This setting created a perfect opportunity to evaluate how pronghorn react to construction, crossing structures and impermeable fencing along a 6,000 year old migration path. While the goal of this mitigation was to reduce wildlife-vehicle collisions and increase permeability of the landscape for wildlife, novel structures in a migratory path may increase wildlife stress-levels or even truncate migrations. We found evidence of risk-avoidance behaviors in pronghorn at this mitigation site; however, we also detected evidence that pronghorn gradually acclimate to wildlife crossing structures. At the conclusion of the study, pronghorn still exhibited higher levels of vigilance when approaching the structures, but successful use of the overpass had increased. Some issues with the mitigation project that could have led to heightened stress include the sequence of project construction, the installation of fencing at the entrance and exit of the overpass and the continued presence of cattle fences near the crossing structures.

Abstracts – Contributed Presentations, 2016

Alphabetical by First Author

DETERMINANTS OF PRONGHORN ANTELOPE SEASONAL RANGE AND MIGRATION IN THE UPPER SNAKE RIVER PLAIN, IDAHO

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Pronghorn antelope can have diverse behaviors in relation to their seasonal movement ranges and/or migration patterns. Pronghorn of the Upper Snake River Plain have a diversity of seasonal range and movement patterns that are predominantly migratory but also contain small populations and individuals that are non-migratory (residential). Using net-squared displacement procedures (NSD), seasonal ranges and migrations are estimated and characterized from GPS collar data deployed between 2003 and 2015 on does across the study region. Individual pronghorn does' seasonal movement patterns were estimated from the location data where they were characterized as seasonally migratory or residential. From these classifications of individual movement patterns, we can determine differences between migratory and residential individuals in their winter and summer ranges across a spectrum of environmental covariates known to effect pronghorn habitat suitability (i.e., Snow depth, vegetation type, elevation, NDVI, paved road density etc.). For those individuals that have a migratory behavior, we perform a case controlled resource selection function modeling exercise to examine the covariates that determine location selection during the spring and fall migrations. These findings will then be used to evaluate different survey times and techniques for the purposes of providing pronghorn managers population estimates.

MODELING TRANSLOCATION STRATEGIES FOR PRONGHORN POPULATIONS IN THE TRANS-PECOS, TEXAS

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In 2011, the Borderlands Research Institute and Texas Park and Wildlife Department (TPWD) began an effort to boost populations of pronghorn (*Antilocapra americana*) in the Trans-Pecos region of Texas. Restoration efforts focused on translocating groups of pronghorn from the Texas Panhandle. Pronghorn are endemic to North America. Archaeological records, Native American paintings, and testimony of European settlers place large herds of pronghorn in the Trans-Pecos for millennia. The influx of human settlement to the Trans-Pecos, beginning in the late 1800s, saw fluctuations in the regional pronghorn populations due to habitat fragmentation, overhunting, change in land-use practices, and drought. Since 1978, TPWD has collected population estimate data using aerial line transect surveys in the Trans-Pecos. A decrease from >17,000 pronghorn in the 1980s to a low of <4,000 in 2011 led to the initiation of translocation efforts. Ecological modeling is a tool that has been utilized in population viability analysis to evaluate the potential impacts of various management scenarios. Habitat fragmentation in the Trans-Pecos has caused multiple metapopulation arrangements which TPWD manage as unique herd units. We sought to evaluate potential for each herd unit to serve as a source or sink population. We used 30 years of aerial population estimates, fawn production, and survival data from recent studies on pronghorn in the Trans-Pecos to develop a simulation model. We also used various demographic and translocation timing combinations to determine projected long-term success of translocation on population viability.

TO JUMP OR NOT TO JUMP: MULE DEER (*ODOCOILEUS HEMIONUS*) AND WHITE-TAILED DEER (*ODOCOILEUS VIRGINIANUS*) CROSSING DECISIONS

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Mule deer (*Odocoileus hemionus*) and white-tailed deer (*Odocoileus virginianus*) negotiate barbed-wire fences by either jumping over or crawling under fencing. We examined crossing success and decisions of these two species to determine factors that influence crossing success and the impending decision to jump over or crawl underneath fencing. Using a Before-After-Control-Impact design, we deployed remote cameras along fence lines in three study areas across South-eastern Alberta and North-central Montana. Using logistic regression, we modelled the probability of deer successfully crossing and the decision between crawling under versus jumping over fencing based on demographic, environmental, and fence variables. Overall, 165 of 329 successful crossings (50%) occurred by crawling under fencing. Males were less successful (P=<0.01) and crossed under less (P=<0.01) than females. White-tailed deer crossed more successfully (P=0.046) but under less than mule deer (P=<0.01). In reference to spring, deer were more likely to cross successfully and under during the fall (P=<0.01, P=0.012) and summer (P=0.022, P=<0.001). Deer were also more successful at crossing during the winter(P=<0.001), but by jumping over (P=0.75). Bottom wire heights positively influenced crossing success (P=<0.01) and crossing underneath (P=<0.01). Calculated odds ratios showed that clip enhancements had the highest crossing success rate (94%) and were the most used enhancement type. Goat bars were the least successful (17%) and least used enhancement type. When applying wildlife-friendly fencing strategies, we recommend increased opportunities for deer to cross under fencing by using clips to raise the bottom wire and suggest goat bars may act as a crossing deterrent.

HEMORRHAGIC DISEASE IN MONTANA PRONGHORN

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Bluetongue virus and epizootic hemorrhagic disease have been documented in Montana for decades. Recently the range of these hemorrhagic diseases has expanded into the western part of the state. Montana has experienced localized and variable population declines in wild cervids as well as pronghorn when these outbreaks occur. In 2007 the United States experienced one of the largest hemorrhagic disease outbreaks with an estimated 60,000 deer mortalities. Much of eastern and central Montana saw marked declines in pronghorn populations that year, followed by subsequent reductions in recruitment. During the fall of 2010, Montana Fish, Wildlife and Parks distributed sample collection kits to pronghorn hunters in two hunting districts: HD 513, which declined during the 2007 outbreak, and HD 510, which remained stable over the same period. The goal was to collect serum and fecal samples to assess exposure to a variety of diseases and parasites that could provide insight into the overall health of pronghorn herds occupying these areas. Five of 88 animals in our sampling efforts were positive for exposure to hemorrhagic disease (2% in HD 510 and 9% in HD 513). Since 2007, the population in HD 513 has continued to experience depressed recruitment and consistently low total counts, whereas HD 510 has remained stable. Little is known about the long-term effects of hemorrhagic diseases, but here we present hypotheses for the continued depression of HD 513's population post-outbreak.

ASSESSING TRANSLOCATED PRONGHORN ADULT AND FAWN SURVIVAL IN NEW MEXICO

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Translocations have been a common component of pronghorn management across the western United States to augment declining or re-establish extirpated populations. However, in most cases, post translocation monitoring has either been minimal or non-existent. In 2013, NM Department of Game and Fish entered into an agreement with a ranch located east of Cimarron, NM to reduce winter crop depredation by pronghorn while simultaneously translocating those captured individuals to supplement declining populations in the southeast New Mexico. We monitored and assessed the success of adult pronghorn translocation as a management tool in New Mexico for translocations occurring in 2013 and 2014. Low fawn:doe ratios were observed in 2013 (6:100), resulting in a closer examination of fawn survival from translocated does in 2014 and 2015. A total of 144 adults were translocated to Fort Stanton over two years (61 male and 83 female). Adult survival was estimated for both year of translocation (2013 and 2014) as well as year post translocation (2013 animals in 2014). Adult survival was high in both year of translocation (0.68 ± 0.08 in 2013 and 0.91 ± 0.06) and year post translocation (0.95 ± 0.05). Twenty nine fawns were captured in 2014 and 31 fawns in 2015. Fawn survival for 2014 was 0.01 (± 0.1) and (0.04 ± 0.3) for 2015. High adult survival indicates translocation success at the site. However, poor fawn survival in both years suggests future efforts should focus upon identifying and remedying potential limiting factors negatively impacting fawn survival in this localized population.

ARIZONA ANTELOPE FOUNDATION SOUTHEASTERN ARIZONA GRASSLANDS PRONGHORN INITIATIVE

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In 2011, 2013, and 2014 the Arizona Antelope Foundation (AAF) was awarded 3 different Sky Islands Initiative-National Fish and Wildlife Foundation (NFWF) grants totaling $510,000 to support the AAF's 10-year Southeastern Arizona Grasslands Pronghorn Initiative initiated in April 2010. Matching non-federal contributions valued at $800,000 include: AAF and private land owner project labor and materials; Pima County Sonoran Conservation Plan land acquisition funds and Arizona Game and Fish Big Game Tag Habitat Partnership Funds. The "Southeast Arizona Collaborative Grassland Workgroup", created in February 2010, collaboratively drafted a southeastern Arizona Regional Pronghorn Strategy to: Increase Pronghorn population numbers, distribution and connectiveness. Partners in this working group include: AAF, AZGFD, BLM, USFS, SLD, USDA, USFWS, NRCS, and Pima County, Arizona Wildlife Federation, AZ Land Trust, Audubon Society, Tombstone High school and local ranchers/landowners. Long-term goals for this 7-year grant period 2011-18 are to; 1) establish a region-wide dynamic geodatabase with integrated multi-species layers to prioritize grasslands restoration/maintenance activities for pronghorn and other sensitive grassland species, 2) permanently record pronghorn travel corridors and remove or modify barriers, including fences, shrubs and trees, 3) target/plan grassland treatments/burns in priority habitat locations on an annual and long-term basis to benefit the highest number of keystone grassland species, 4) supplement at least one pronghorn population and increase numbers in two subpopulations and 5) improve grassland habitat in five pronghorn subpopulation zones. We discuss the projects measureable progress to date regarding acres of grassland restoration, connectivity acres through fence modifications, predator removal and population supplements and increases.

FENCE CROSSING OF TRANSLOCATED PRONGHORN IN THE TRANS-PECOS, TEXAS

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Translocations have been an important tool in improving and sustaining pronghorn antelope (*Antilocapra americana*) populations, particularly in areas where pronghorn

have been nearly extirpated. However, agricultural fencing has the potential to restrict the effectiveness of restoration efforts. In west Texas, movement is inhibited by barbed and net-wire livestock fencing. Following translocations from the Texas Panhandle to southwestern Marfa Plateau in 2011, the Marathon basin 2013, and southeastern Marfa Plateau in 2014; we monitored movements of 27 (16 F, 11 M), 49 (43 F, 6 M), and 39 (35 F, 4 M) animals (age 1–4+) equipped with GPS collars. Collars were programmed to record 1 location/hour for 38 weeks post-release. We began fence modification efforts in 2013 for the Marathon Basin release. Modifications entailed raising the bottom of a barbed or net-wire fence to a minimum of 45.7 cm from the ground in stretches of 9–27 m using intervals of 0.8 km. Priority was given to fence corners, natural travel corridors, and grassland draws. Using location data from 3 different study sites over 3 different years, we sought to analyze movements of individual pronghorn. Our objectives were to: 1) total the number of fence crossings and attempted crossings by date, region, sex, and age, 2) understand frequency of fence crossings by fence type, 3) document the "pronghorn unfriendly" fences in our restoration areas to be targeted for future modification efforts, 4) document patterns of pronghorn movement influenced by fences.

PREDICTING LONG-TERM PRONGHORN POPULATION DYNAMICS IN THE SOUTHWEST IN RESPONSE TO CLIMATE CHANGE

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Over this century, the southwestern US is predicted to experience higher temperatures and more variable precipitation patterns, which will significantly alter grassland habitats. Developing a better understanding of the impacts of climate on species inhabiting these arid regions is critical for their management and conservation. We examined historical relationships between environmental factors and pronghorn (*Antilocapra americana*) population dynamics to gain insight into their potential response to predicted changes in climate. We adopted an information-theoretic approach in a Bayesian framework to analyze long-term data from 18 pronghorn populations in the Southwest, to determine climatic factors that predict annual rate of population growth (λ). We used these explanatory variables to project pronghorn population trends to 2090 in response to

climate change under high and lower atmospheric CO_2 concentration scenarios using region-specific downscaled climate projection data. Climate projections on pronghorn range indicate increased temperatures across the region, and direction and magnitude of precipitation changes show high area-specific variation. Fifteen populations demonstrated a significant positive relationship between precipitation and λ, with late gestation and lactation being important periods, whereas temperature relationships were highly variable. We found little difference in pronghorn population projections between atmospheric CO_2 concentration scenarios. Our models predict that more than half (56%) of the pronghorn populations examined will be extirpated or approaching extirpation by the end of the century. Findings will contribute to a better understanding of ungulate response to a changing climate, which will benefit development of management and conservation strategies for species on arid lands.

POST-RELEASE SURVIVAL OF TRANSLOCATED PRONGHORN ON THE MARFA PLATEAU, TEXAS

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Recent severe population declines in pronghorn (*Antilocapra americana*) in the Trans-Pecos region of Texas prompted restoration efforts by Texas Parks and Wildlife Department and the Borderlands Research Institute at Sul Ross State University in 2011. Translocation, the intentional release of animals from one site into another, has often been used as a vital wildlife management tool to help restore vulnerable taxa. Therefore, translocations were used to supplement critically low populations in portions of the Trans-Pecos region (Marfa Plateau and Marathon Basin). Our objectives were to (1) evaluate success of restoration efforts, and (2) monitor mortality and factors that affect survival. All translocation efforts (2011, 2013, 2014, and continuing in 2016) have involved capturing pronghorn from healthy populations in the Panhandle region of Texas and relocating animals to the Trans-Pecos utilizing the net-gun capture method. In early 2016, we translocated a total of 112 pronghorn from areas around Dalhart, TX to the northwest Marfa Plateau, where 70 of the animals were equipped with either VHF, GPS, or satellite tracking radio-collars. For the first month after release, we conducted weekly aerial telemetry flights while additionally tracking collared animals on

the ground 2–3 times per week. Following the first month, we conducted bi-weekly to monthly aerial telemetry flights. Status of radio-collar mortality signals (live/mortality), visual confirmations, group sizes, and GPS locations were recorded during flights and ground tracking. When GPS/VHF collars emitted a mortality signal, we marked the location of the signal and further investigated potential cause of mortality. As of 25 weeks following post-release, there have been 7 mortalities, with a total estimated survival rate of 90%. Six of the mortalities occurred within 10–14 days post-release and were likely from the effects of capture related injuries/myopathy.

IMPACTS OF SEVERE WINTER WEATHER ON PRONGHORN SURVIVAL IN PARTIALLY MIGRATORY POPULATIONS

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The importance of migration to conserving ungulate populations is recognized across a variety of ungulate taxa, yet the demographic benefits for migratory individuals remain uncertain. We used a time-to-event approach to compare survival and cause-specific mortality rates across migration strategies and seasons for pronghorn (*Antilocapra americana*), a long-distance migrant, and test whether migration strategy mediated the effect of winter weather severity on mortality risk. We radio-collared 175 adult female pronghorn at the northern limit of their range in northern Montana, southeastern Alberta and southwestern Saskatchewan during 2004–2011. Annual survival probability was 7% higher for migratory adult female pronghorn ($S_{\mathrm{mig}} = 0.82$) compared to residents ($S_{\mathrm{res}} = 0.75$), but this difference was not statistically significant ($P = 0.23$). Summer survival of pronghorn was higher ($S = 0.92$) and less variable ($P = 0.31$) compared to lower ($S = 0.86$) and more variable ($P = 0.001$) winter survival rates. Mortality was negligible in autumn and spring. Human-related mortality was most important during summer (CIF = 0.04), while natural, non-predation mortality (CIF = 0.04) was most important in winter, followed by predation (CIF = 0.03) and human-related mortality (CIF = 0.02). We found no interaction between winter weather severity and migration strategy ($P = 0.29$), and winter survival was best explained by the negative effects of winter weather alone.

Despite the high survival typical of adult female ungulates, our analysis suggests a large demographic advantage of migration in a long-distance migratory ungulate that has implications for conserving migratory corridors across the landscape.

FINDING NEW WAYS TO MANAGE PRONGHORN POPULATIONS IN THE TEXAS PANHANDLE – UPDATE

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The current method of issuing pronghorn permits in the Texas Panhandle requires knowledge of pre-season pronghorn population and information about landownership. Obtaining this information is labor intensive and expensive. To address these and other issues with Texas Parks and Wildlife Department's (TPWD) current method of permit issuance, an experimental season was implemented in three herd units (high, moderate and low density). In these units landowners have complete control over hunting intensity/pressure on their property for bucks, but landowners are provided with harvest guidelines. Pronghorn harvest may be independent of survey results or property size, which is the harvest regime for other big game species in Texas. We have tested the experimental season over the past three hunting seasons (2013–2015). TPWD is closely monitoring the experimental season with mandatory check stations to monitor buck harvest intensity, age structure (estimated using cementum annuli), and horn development in each class, as well as conducting population surveys for these areas. Harvest varied among the three herd units. In the high and low density units, harvest exceeded the TPWD "guidelines", but the harvest rate has decreased since 2013. In the medium density unit, harvest was similar to historic levels. Results indicate that population trends within the experimental areas are similar to adjacent non-treatment areas. However, average age of harvested bucks within the experimental areas after three hunting seasons was 3.3, younger than the initial year ($\bar{x}$ = 3.7; 2013), and younger than bucks harvested outside of the experimental areas ($\bar{x}$ = 4.4) during 2015. On average, horn measurements are greatest at 5.3 years of age, but similar to age classes ≥ 3.3. Stakeholder surveys conducted post-experiment indicated that the majority are in favor of continuing or even expanding the concept to new herd units. TPWD will continue with the experimental season in the three designated areas for an

additional year with plans of expanding to three additional herd units while intensively monitoring pronghorn populations to determine effects.

FACTORS INFLUENCING SEASONAL MIGRATIONS OF PRONGHORN ACROSS THE NORTHERN SAGEBRUSH STEPPE

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Globally, grassland systems have received the highest impacts from human activities, and therefore management of these systems is important for ungulate conservation. Pronghorn (*Antilocapra americana*) may undertake seasonal migrations to satisfy annual life history requirements. The effects from environmental gradients and anthropogenic factors on pronghorn migrations are not well understood. Our objectives were to: 1) Classify and determine metrics for migration behaviors across individuals in

the Northern Sagebrush Steppe (NSS); 2) Predict multi-scale seasonal pronghorn migration pathways across the NSS and integrate scales into one spatial prediction and; 3) Create pronghorn connectivity network maps across the NSS. Based on 170 animal years from collared females, 55% of individuals undertook seasonal migrations. Using between-class analysis of metrics, three distinct movement groupings were identified. Next, we modelled multi-scale migratory pathway selection in response to environmental and anthropogenic parameters. Generally, migratory pronghorn selected grasslands, intermediate slopes, and south-facing aspects, and avoided increased well and road densities. Pronghorn selected stopover sites with higher forage productivity values and lower well densities versus migratory pathways. We then used a scale-integrated mapping approach and found that these spatial predictions performed as well or better than single order scales to predict migration pathways. Finally, using a suite of approaches, we created seasonal pronghorn connectivity networks across the NSS. We concluded that multi-scale migration followed hierarchically nested theory where finer scale decisions are conditional on broader scales that can be assessed sequentially. We suggest that the pronghorn is a broad-scale focal species useful for conservation planning across the NSS.

EVALUATING THE USE OF MODIFIED FENCE SITES BY PRONGHORN IN THE NORTHERN SAGEBRUSH STEPPE

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Pronghorn (*Antilocapra americana*), typically prefer to cross barbed-wire fencing by crawling under the bottom wire versus jumping over. If the bottom wire is too low, a fence can act as a semi-permeable or complete barrier and thus, restricts pronghorn movements. A number of fence modification techniques have been recommended by wildlife management agencies to enable the movement of pronghorn under fences but none have been critically evaluated. Our study tests whether pronghorn will use modified fence sites, monitored with remote trail cameras, using a Before-After-Control-Impact study design. We tested the pronghorn use of goat-bars, clips, and bottom wire

composed of smooth wire to determine if specific fence modifications facilitate easier passage by pronghorn at study sites in Alberta and Montana. We used ANOVA to test if both the magnitude in change and relative change in successful crossings was significantly different between modified sites, control sites and historic crossing locations. We used logistic regression to determine demographic, environmental and fence parameters that influence successful crossings by pronghorn. We discuss our interpretation of the results and implications for each technique to facilitate pronghorn daily and seasonal movements. This evaluation will allow mangers across the entire range of pronghorn to make informed recommendations to the ranching and conservation community as to which enhancements are appropriate and likely to increase fence permeability for pronghorn.

DOES BIRTH SYNCHRONY INFLUENCE FAWN SURVIVAL OF PRONGHORN IN THE TRANS-PECOS REGION OF TEXAS?

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Birth synchrony is an often used strategy by ungulates functioning to reduce risk of predation on young by increasing prey availability. The goal of birth synchrony is to saturate prey availability in a short time frame to predators and reduce individual risk of predation. In most of their range, pronghorn fawns are born within a 3-week period during early spring, and peak fawning occurs over a 10-day period. Our objectives were

to: 1) determine the length of the pronghorn fawning season in the Trans-Pecos region of Texas, 2) identify the peak period of fawning, 3) determine cause specific mortality of fawns, and 4) estimate fawn survival rates. Using spotlights and vaginal implant transmitters we located and fit pronghorn fawns with expandable VHF radio collars. Collared fawns were monitored throughout the fawning season. We found the fawning season ranged between 30 and 56 days. Pronghorn in the Trans-Pecos do not appear to have a significant peak fawning period as described elsewhere. Predation accounted for the majority of fawn mortalities, with coyotes and bobcats being the primary predators. There was no difference in survival of fawns born during peak fawning periods and those born outside of peak periods. Fawn survival rates increased with increasing precipitation across study sites.

ENVIRONMENTAL CONSTRAINTS ON PRONGHORN NEONATE SURVIVAL ACROSS IDAHO

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Idaho pronghorn populations have failed to rebound to previously high levels found in the late 1980s. Pronghorn population recruitment is driven by nutritional conditions, climate, and predation. We are examining neonate pronghorn survival across Idaho, in three distinct study sites. The study sites will include habitat types of: native high elevation shrub-steppe, altered/low quality shrub-steppe, and agricultural based habitat. Neonates will be collared and monitored daily to determine survival-ship of the fawns. Morphological measurements of fawns along with bed site cover selection were taken during collaring. Predator track plate surveys were completed to estimate predator densities. Alternative prey species were surveyed to estimate densities. Pronghorn fecal samples will be collected to assess fecal nitrogen and DAPA indices as a measure of habitat quality across the different populations. We will then compare survival rates across the three study sites and survival across the covariates collected throughout the study.

CREATION AND EVALUATION OF TREND AREAS THAT PREDICT PRONGHORN POPULATIONS TO GUIDE MANAGEMENT ACTIONS

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Trend area flights offer substantial cost and time savings over total population counts, but trend area data need to be calibrated to total count data before they can be used with confidence in wildlife management decisions. To develop trend areas for pronghorn in FWP Administrative Region 5, Montana, herd location data from total surveys, for the period 1984-2009, were combined with classification information by hunting district (HD) into a GIS. Grids, 5 mile (mi.) x 5 mi. to 12 mi. x 12 mi. (increasing by 1 sq. mi. intervals) in size were overlain on the pronghorn locations as potential trend areas. The total number of pronghorn by year were calculated for each grid and cross-referenced with HD census data. The predictive ability of each candidate trend area was estimated and internally validated. We selected grids with the highest internally validated predictive ability to be used as trend areas for each HD. Correlation coefficients between trend count data and total count data varied from a low of .88 to a high of .98. Newly established trend areas varied in size from 64.3 sq. mi. to 216.6 sq. mi. Trend areas have been surveyed in Region 5 for 8 years and biologists believe that population trend information has improved management with substantial savings in time and expense. However, trend areas failed to detect the severity of population declines in some HD's during a bluetongue outbreak. The survey design incorporates these catastrophic population lows into our models improving predictive ability in the future.

SURVIVAL OF PRONGHORN IN WYOMING'S RED DESERT: THE INFLUENCE OF INTRINSIC FACTORS AND ENVIRONMENTAL AND ANTHROPOGENIC CHANGE

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Pronghorn (*Antilocapra americana*) in Wyoming have declined by 28% from population highs reached in 2007. Over the same period, herds in the Red Desert of south-central Wyoming have seen declines in herd size of up to 35%. In addition to population declines over the past decade, Red Desert pronghorn herd estimates have frequently been below Wyoming Game and Fish Department objectives for over 20 years, and permitted hunting has declined considerably. Recently, the Red Desert region has experienced drastic changes in environmental conditions, with droughts becoming increasingly frequent and severe. In addition, portions of the area have been intensely developed for natural gas and coalbed methane extraction. To better understand the effects of such environmental and anthropogenic change, we monitored 132 adult female pronghorn across four study areas, each with differing levels of resource extraction intensity, between November 2013 and February 2016. We used the Cox Proportional Hazards regression model to identify covariates contributing to the risk of death for pronghorn. Covariates were related to environmental conditions, anthropogenic infrastructure, and intrinsic factors. Over the course of our study, we observed 41 deaths, with a Kaplan-Meier survival rate estimate of 65.1% (95% CI: 57.2−73.0).Our results enhance knowledge of pronghorn demographic responses to increasing climatic variability and anthropogenic disturbance. Given that greater than 50% of all pronghorn occur in Wyoming, it is crucial that we improve our ability to understand the influence of intrinsic factors, environmental change, and resource extraction on pronghorn populations in the state to guide management and mitigation.

REDUCING CROPLAND CONVERSION RISK TO SAGE-GROUSE THROUGH STRATEGIC CONSERVATION OF WORKING RANGELANDS

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Conversion of native habitats to cropland is a leading cause of biodiversity loss. The northeastern extent of the sagebrush (*Artemisia* L.) ecosystem of western North America has experienced accelerated rates of cropland conversion resulting in many declining shrubland species including greater sage-grouse (*Centrocercus urophasianus*). Here we present point-process models to elucidate the magnitude and spatial scale of cropland effects on sage-grouse lek occurrence in eastern Montana, northeastern Wyoming, and the Dakotas. We also use a non-parametric, probabilistic crop suitability model to simulate future cropland expansion and estimate impacts to sage-grouse. We found cropland effects manifest at a spatial scale of 32.2 km^2 and a 10 percentage point increase in cropland is associated with a 51% reduction in lek density. Our crop suitability model and stochastic cropland build-outs indicate 5-7% of the remaining population in the region is vulnerable to future cropland conversion under a severe scenario where cropland area expands by 50%. Using metrics of biological value, risk of conversion, and acquisition cost to rank parcels, we found that a US $100M investment in easements could reduce potential losses by about 80%, leaving just over 1% of the population in the region vulnerable to cropland expansion. Clustering conservation easements into high-risk landscapes by incorporating landscape-scale vulnerability to conversion into the targeting scheme substantially improved conservation outcomes.

EVALUATION OF AERIAL POPULATION ESTIMATION TECHNIQUES FOR PRONGHORN ANTELOPE IN TEXAS

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Aerial surveys are an efficient way to track population trends of large mammals, but often underestimate population size because some animals are not seen. Methods to correct for visibility bias are available, but must be validated for the habitat and survey protocols to which the correction will be applied. In Texas, aerial surveys for pronghorn (*Antilocapra americana*) are flown on strip transects using a fixed-wing aircraft at low altitude (30.5 m) to obtain abundance and herd composition estimates. We evaluated the performance of distance sampling and sightability modeling for aerial surveys of pronghorn in the Panhandle and Trans-Pecos regions of Texas. Pronghorn were captured and fitted with GPS collars at 2 sites in each region during March 2014 (Panhandle: Dalhart, Pampa) and February 2015 (Trans-Pecos: Alpine, Marathon). We surveyed herd units that contained collared pronghorn during June 2014 and 2015, and recorded activity, group size, habitat type, percent cover, terrain, color, and distance from the survey line. We used distance sampling and sightability modeling to estimate population size for each individual site, and compared all results to independent estimates derived via mark-resight. Traditional estimates underestimated population size, with a 16% difference when compared to mark-resight estimates, 33.4% to distance sampling estimates, and 18.5% to sightability modeling estimates. Pronghorn detection probabilities were similar to past studies at 51.9% according to sightability modeling and 64.9-66.5% according to distance sampling. Significant factors in the sightability model were animal activity, distance, cover, and color, whereas activity was the only significant variable in distance sampling.

MONTANA'S GRASSLAND CONSERVATION STRATEGY

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Montana is believed to have one of the last strong-holds of intact mixed grass prairie in North America. Over one quarter of Montana's landscape provides habitat for grassland-associated wildlife species, however, the amount and intactness of native

grassland is declining every year. Montana Fish, Wildlife and Parks (FWP) is developing a grassland conservation strategy designed to guide FWP's habitat conservation actions for sustaining viable populations of grassland-associated wildlife while recognizing important economic and social drivers in the grassland ecosystem. We will provide an overview of how we propose to prioritize landscapes for conservation to maintain and enhance the largest, most intact areas of grassland in the state. We will also discuss the spatial distribution of threats, ongoing conservation actions, and relevant conservation tools so we can target the right conservation action in the right places. We plan to conduct implementation and effectiveness monitoring to track success. Our hope is that this strategy, when combined with other grassland conservation efforts, will ensure the long-term persistence of functioning grassland systems in Montana.

Abstracts – Contributed Posters, 2016

Alphabetical by First Author

FOLLOW-UP OBSERVATIONS OF A SMALL POPULATION OF TRANSLOCATED PRONGHORN (*ANTILICAPRA AMERICANA*) NEAR HILLSIDE, ARIZONA

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We documented a 7-year persistence of a remnant population of 4 to 9 pronghorn near Hillside, Arizona, from May 2008 through November 2014. Follow-up surveys through May 2016 showed a population of 5 individuals— 3 adult females, 1 female yearling, and 1 adult buck in a pasture of *ca.* 866 ha. Although the possibility exists of animals immigrating or emigrating from the Hillside area, we did not document such behavior during our study. With no overt management actions this population has persisted for >8 years with a mean annual recruitment rate of 35 yearlings:100 adult does. The loss of 4 animals during 2015-2016 may leave only 1 buck remaining and be attributed to a May 2014 Palmer Drought Severity Index of -4.09.The continued presence of this population is attributed to low adult doe mortality and a greater recruitment of females than males on a well-managed rangeland.

DEVELOPMENT OF POPULATION GENOMIC TOOLS FOR CONSERVATION AND MANAGEMENT OF WYOMING PRONGHORN

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Wildlife requiring large, contiguous landscapes for dispersal and seasonal movements are particularly vulnerable to reduced connectivity and population declines caused by anthropogenic landscape alterations. As humans continue to encroach on natural landscapes, it becomes increasingly critical to characterize and maintain genetic diversity and gene flow for impacted wildlife species. Pronghorn (*Antilocapra americana*) populations have experienced historical declines because of overharvest and habitat loss and currently face threats of manmade barriers to movement. Using genetics, we can assess the underlying effects of these human impacts at a population level, adding vital and complementary data to population surveys, GPS tracking studies, and other existing pronghorn research. First, we are developing statewide genomic data for Wyoming pronghorn to determine broad scale patterns in genetic diversity. To do this, we sequence muscle tissue samples collected by the Wyoming Game and Fish Department at hunter check stations in 2015. We are utilizing double digest restriction-site associated DNA (ddRAD) sequencing to discover and genotype thousands of single nucleotide polymorphisms (SNPs). This approach generates larger quantities of data at lower cost than more traditional methods such as microsatellites. This large volume of DNA sequence data allows for detection of genetic structure and calculation of important monitoring indices (e.g., effective population size, relatedness among individuals) even with low genetic diversity populations that previously would have prohibited such analyses. We present preliminary results toward the aim to identify natural and manmade barriers to gene flow, classify essential dispersal corridors, and provide management agencies with genetic population delineations for Wyoming.

WHERE THE ANTELOPE ROAM: ANALYSES OF HOME RANGE SIZE AND HABITAT USE OF GPS-COLLARED PRONGHORN IN TEXAS

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Movements and habitat use of pronghorn antelope (*Antilocapra americana*) are influenced by anthropogenic effects on the landscape, including livestock fences and brush encroachment. However, the effects of landscape alteration on pronghorn have rarely been quantified. We evaluated pronghorn home range and habitat use in a mosaic of agriculture and livestock production in Texas. Pronghorn were captured and fitted with GPS collars at 2 sites in the Panhandle (Dalhart, Pampa) during March 2014 and Trans-Pecos (Alpine, Marathon) during February 2015. We determined seasonal home range size through kernel density estimation using statistically independent data that was ≥ 120 minutes apart to ensure we did not underestimate home range size. Habitat use and availability were quantified on the animal and landscape scales based on classification of 10-m ecological system raster data. We observed that pronghorn movement was limited most by fencing and high-traffic highways. There was no difference in home range size between the sexes, but home range size was larger in the Panhandle (Dalhart = 11.7 km^2, Pampa = 12.3 km^2) than the Trans-Pecos (Alpine = 1.9 km^2, Marathon = 7.3 km^2). Habitat use for each region corresponded to site habitat availability. Pronghorn in the Panhandle used 60.3% grassland (available: 55.7%), 19.8% shrubland (19.6 available), and 16.6% agriculture (19.9% available). Trans-Pecos pronghorn used 70.1% grassland (64.9% available), 18.3% shrubland (20.8% available), and 11.3% scrub (13.9% available). We propose that differences in pronghorn home range size between the ecoregions are due to livestock fencing, agriculture, and brush encroachment.